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NOTICES OF The Aëronautical Society.

At a meeting of the Council held at the Society of Arts, John Street, Adelphi, on March 11th, 1902, the following gentlemen were elected members of the Society:—

Mr. MARK BARR.
Mr. THOMAS FRAZER.
Mr. WILLIAM GUY.
Mr. HERBERT FETHERSTON LLOYD.
Mr. F. N. MRAZSEK.
Mr. ALEXANDER SMART.
Mr. S. LAWRENCE SWINBURNE.
Mr. PETER WILLIAMS.

The next General Meeting of the Aëronautical Society of Great Britain will take place in July, particulars of which will be duly announced.

ANNUAL SUBSCRIPTIONS.

The Annual Subscriptions to the Aëronautical Society were due in January last. Those Members who have not yet paid their Annual Subscriptions are requested to forward them to the Honorary Secretary, 19, Campden House Road, Kensington, London, W. The attention of those Members is called to Rule IVA., which states that the privileges of Members extend only to those who have paid their subscriptions for the current year.

SCIENTIFIC BALLOON ASCENTS.

It is the intention of the Council of the Aëronautical Society to arrange some Balloon Ascents for strictly scientific purposes, and an ascent will be made this summer for the purpose of investigating the direction, strength, and thickness of aerial currents encountered during the voyage, a research which is of paramount importance to the progress of Aerial Navigation, whether its ultimate solution is to be accomplished by the body that is heavier than air or lighter than air. The Council are fortunate in having secured the co-operation of so eminent a meteorologist as Mr. Charles Harding, F.R.Met. Soc., who has had past experience in scientific investigations from balloons, and who has kindly consented to take the necessary observations.

Due notice will be given to Members of the Society as to date and place of the ascent.

INTERNATIONAL KITE COMPETITION.

There will be an International Competition for the Highest Kite Flight under the auspices of the Aëronautical Society of Great Britain, in 1903. Further particulars will be shortly announced.

ERIC STUART BRUCE,
Honorary Secretary.

GENERAL MEETING.

The second meeting of the Session of the Aëronautical Society was held at the Society of Arts, John Street, Adelphi, on Tuesday, March 11th, 1901. Sir Hiram Maxim in the chair.

The Honorary Secretary read the Minutes of the last meeting and also a letter received from the German Ambassador expressing to the Council his great regret that, owing to a previous engagement he was prevented from being present on the occasion of the present meeting.

The CHAIRMAN: Miss Pilcher, who is an honorary member of our Society and sister of Mr. Percy Pilcher, who lost his life in making experiments with a view of navigating the air, has presented to our Society all the photographs, note-books, lantern slides and apparatus which the late Mr. Pilcher left, and I suggest a vote of thanks be sent to Miss Pilcher for her kindness in this direction.

We have received a communication from the St. Louis Exhibition which our Secretary will now read.

The Honorary Secretary then read the following communication from the Directors of St. Louis Exhibition:—

It has been fully and finally determined on the part of the officers of the Exposition to have a tournament of airships and an aërostatic congress at the World's Fair in 1903. In order to stimulate inventors along this special line of experiment, prizes aggregating 200,000 dols. will be offered for the most successful contestants. In view of the remarkable results attained by M. Santos-Dumont at Paris last year, when he made a thirty-minute trip around the Eiffel Tower, having his airship under control during the entire journey, the coming tournament is in the line of progress. It is the desire of the officers to achieve better results than those of Santos Dumont, and for that reason the prize is made a most liberal one.

When the classification of exhibits was prepared by Mr. Frederick J. V. Skiff, Director of Exhibits, he included in the Department of Transportation, in Group 77, four classes of exhibits relating to aërial navigation. Class 481 relates to balloon construction; fabrics, varnish, cars, valves, netting, cordage, appliances for stopping balloons, such as anchors and grapnels, the generation of hydrogen and other light gases, captive balloons. Class 482 relates to aërial voyages, the use of balloons for the study of the atmosphere, air currents, clouds, temperature at great heights, optical phenomena, etc., drawings, maps of journeys, diagrams, photographs. Class 483 relates to military ballooning; military captive balloons and their accessories, winding drums, transport wagons, apparatus for inflation. Class 484 relates to aërial navigation, dirigible balloons and guiding apparatus, flying machines, screw propellers, aëroplanes and parachutes. The fourth class mentioned is the one having a particular public interest at the present time.

It was early recognised by the officers of the Exposition that the navigation of the air is one of the great problems for scientific solution, and that this Exposition would not fulfil its duty to the world unless it lent its encouragement and furnished an opportunity for those who are skilled in this difficult science to demonstrate the results of their endeavours.

The experiment of M. Santos-Dumont has set the inventors to thinking anew upon this most interesting problem, and the tournament at the coming World's Fair will be one of the most novel in history. A cablegram from London says that Sir Hiram S. Maxim, the American inventor, has expressed himself as being willing to expend 100,000 dols. in addition to the large sums he has already laid out in experiments in aërial navigation to win in the coming contest, if assured that the prize will be as large as announced. In reply to this, President David R. Francis, of the Louisiana Purchase Exposition, is quoted as follows: "Sir Hiram Maxim will receive all the assurance he desires when the committee on aërial experiments has crystallized the plan for the contest. If he abides by the conditions of the competition and invents an airship that will obey the directions of an operator in mid-air, as well as develop speed, he will be entitled to be adjudged as a real contestant.

"The total sum of 200,000 dols. has already been set aside by the executive committee for the purpose of defraying the expenses of the proposed aërial tournament. Of this sum 100,000 dols. will constitute the award for the successful operation of a craft in the air. 50,000 dols. will be devoted to premiums for races between airships, and 50,000 dols to defray the expenses of the competition. We have opened correspondence with noted experts in aërial science, and the entire matter of suggestion with reference to the management of the contest will come from that authority."

Secretary Water B. Stevens, of the Exposition Company, says: "The recommendation

of Director of Exhibits Skiff on the subject of the airship contest has been unqualifiedly endorsed by the entire Executive Committee. Nothing in the way of a suggestion for an exposition feature has received such immediate and strong approval."

The Executive Committee of the Exposition has appointed as a sub-committee in charge of the tournament and congress, Mr. Charles W. Knapp, proprietor of the "St. Louis Republic," and Nathan Frank representing the "St. Louis Star." This sub-committee has invited Prof. S. P. Langley, Secretary of the Smithsonian Institution of Washington, D.C., and Mr. Octave Chanute, of the Western Society of Engineers at Chicago, distinguished scientists, who have devoted much attention to aërostatics, to visit St. Louis for a conference upon the subject of the aërial tournament and aërostatic congress at the World's Fair. At this conference rules for the event will be determined, and a proper division of the 200,000 dols. will be decided upon. It is also probable that they will recommend for appointment a chief of the aërostatic display. The following is the letter addressed to Prof. Langley and Mr. Chanute by Director of Exhibits Skiff:

"At a meeting of the Executive Committee of the Louisiana Purchase Exposition Company, it was determined to recommend to the general Board of Directors of the Corporation that a congress of aërostatics be called and an aërial tournament be held during the International Exposition at St. Louis in 1903, and a large sum of money was tentatively appropriated to defray the expenses of the congress and tournament and to cover the prizes that it is intended to offer.

"The President of the Exposition Company, who is Chairman of the Executive Committee, appointed a special committee of two on the plan and scope for the congress and tournament, the members of the committee being Mr. Charles W. Knapp and Mr. Nathan Frank. At the request of this special committee and with the approval of the President, I beg to ask if it will be convenient and agreeable to you to visit St. Louis at an early date for the purpose of conferring with this special committee?"

The announcement that such a liberal sum would be set aside for the encouragement and experiments in aërial navigation has stirred up a very lively interest in the science, and many inquiries have been received by mail and wire at Exposition headquarters. Secretary Stevens reports that it is possible there will be at least 100 entries representing not less than ten countries.

The CHAIRMAN: It is not strictly true that I offered to spend a hundred thousand dollars on experimenting for the St. Louis Exhibition. I saw it in the papers, and they have written to me on the subject, and I may tell them no one had been authorized to make such a statement. Nevertheless, I may spend some large sum of money in experimenting before that time, but I would say that I have already written to the Committee and have told them that as the Exhibition takes place in a little more than a year, and as no flying machine is yet in existence, I think there is very little hope that anyone will have one at that time. We must remember that these experiments have been going on now for a great number of years, and nobody as yet has made a machine, and to say we are going to make one and have it ready and tried and assured of its success before the Exhibition of next year is making a statement that I do not think we shall be able to fulfil. Then, again, if anyone in England should make a successful flying machine they might put it to a very much better use by lending it to our own Government for reconnoitring the position in South Africa. I think the Exhibition at St. Louis will come to be a Balloon Exhibition, especially as I understand there is a good deal of wind there. But one good thing will certainly result from the Exhibition: it will turn attention in the direction of flying machines and balloons, and it may lead to the development of matters which in the immediate future will be very useful, and although we may not look for a successful flying machine or successful navigation of the air at the St. Louis Exhibition, I feel sure it will turn attention to the subject and will be very beneficial to the study of navigating the air in the future.

The SECRETARY: I may mention that I have been informed by the representatives of the Exhibition in this country that they will kindly furnish me from time to time with statements of all the arrangements of this Exhibition, so that members of the Society who wish to send navigable balloons or take part in the other exhibits will be able to get all the information they need. I shall be happy to put any knowledge I have at their disposal. I myself, as Secretary of the Society, hope that members will send several exhibits to this Exhibition, and, in fact, to every International Exhibition that is held, and I think even if a great advance is not made with the airships

there may be, all the same, a very interesting race. About the exhibits, I think we certainly might make a large show amongst our members in these various groups that I have mentioned, and there should not be the same dearth of Foreign Exhibits as in the case of the Paris Exhibition. In the case of the Paris Exhibition there were only two aëronautical exhibits belonging to foreign exhibitors, all the other exhibits being exclusively French. One of these was my own, being the electric signalling balloon, and the other was from the Russian Government. I hope that will not be the case at the St. Louis Exhibition. I should now like to say one word about the position of our Society in 1902. Facts show how satisfactory it is. 1. Financially as shown by the balance-sheet recently put into the hands of our members. 2. By the increase of our members. 3. By the co-operation of so many distinguished aëronautical authorities in all parts of the world. The wide sympathy with our efforts to promote the advance of aëronautics has been specially evidenced within the last 12 months, no less than three foreign countries having been represented in the paper read at our general meetings—France, America, and Germany.

We still have to regret the absence of our President, the fruits of whose earnest labours for the promotion of aëronautics in this country we are now reaping in the prosperity of our Society, but we hope that before Coronation Day peace may have been restored, and that we may have welcomed him in our midst.

The CHAIRMAN: Major Möedebeck, who wrote the principal Paper of the evening, is not present to-night, but our Secretary will read his Paper, and I am quite satisfied that he will do it quite as well as the author would have himself. We are indebted for the present English translation to Helen A. Bruce.

The Development of Aerial Navigation in Germany.

BY MAJOR W. L. MÖEDEBECK.

I feel it a great honour to read a paper today before you, the oldest Aëronautical Society in the world, with whom I have had amicable relations for now many years. In accordance with the friendly suggestion of your Honorary Secretary, Mr. Eric Stuart Bruce, I propose to bring before you a short outlook over the development of aëronautics in Germany, which I hope will offer to many of you new and unknown facts.

When in 1783 the wave of enthusiasm beat high over the discoveries of Montgolfier and Charles in Paris, the new interest took deep root in the capitals of the numerous small States which in those days constituted Germany. As soon as the principle of an air balloon was understood, the German scientists had hastened to repeat the experiment of Charles for their own people, only on a smaller scale. But their first curiosity once satisfied, the crowd grew discontented, because they had not also seen human beings ascend with the balloon. The Frenchman Blanchard first satisfied this craving amongst us, and everywhere when he ascended in Germany, at Frankfurt a/Main, Hamburg, Aix, Nuremberg, Berlin, Breslau, and Leipzig, he was fêted and honoured. Numerous writings, prints, and memorial medals bring home to us the profound impression Blanchard's air voyages produced on the populace. And at the same time there now awoke the patriotic consciousness of the German peoples. Joseph Maximilian Freiherr von Lüttgendorf, at Augsburg in 1786, was the first German who made a gas balloon, and he fitted it with various little original arrangements. When these first German balloons were to ascend at Augsburg there were extravagant preliminary rejoicings, but the experiment failed miserably on account of the difficulty of filling balloons in adverse weather conditions. Poor Lüttgendorf was unmercifully mocked about it. People were not then sufficiently enlightened on the subject to know that there had always hitherto been this difficulty in filling balloons in unsuitable weather, even in France, and it was only finally overcome by energy, zeal, and experience. The populace had been spoilt in this matter, for it so happened that Blanchard had each time succeeded in this technicality, and so the people were incapable of estimating poor Lüttgendorf's misfortunes rightly.

But I must turn for a moment to Alsace, then under French rule. There at Strasburg, in 1784, two fine Montgolfiers were made, one by Adorn, a mechanic, and the later one, beautifully painted, by Degabriel and Pierre. Also the best book on the "History of Aëronautics," by Kramp, was published in German, at Strasburg: it is now a priceless authority; and at Strasburg, too, a Wurtemberg artist, Enslin, first made the many-shaped grotesque goldbeater's skin balloon figures now only made in Paris. All these historical facts, established by documents, have hitherto been overlooked by writers on aëronautics, who have kept their eyes fixed only on Paris, and

have collated their histories from the well-known and widely-circulated book written by Faugas de St. Fond. In this work misleading statements as to the course of well-known balloon journeys are circulated, and much that is of interest is passed over in silence.

As is known, within a few years of the invention of the Montgolfier, aëronautics fell into disrepute owing to the recognition of the fact that with the means then at disposal it was impossible to make a steerable balloon. Following on Robertson's groundless statements about atmospheric electricity, the first recorded scientific balloon ascents took place under the auspices of the French Academy of Sciences; these were followed up at Berlin, in 1804, by various scientific ascents of Professor Tungius.

We must now pass over for Germany a long period of years barren of aëronautical incident until the war of 1870-71. Then help came to us from you! Your famous aëronaut, Coxwell, came to Germany with his balloon material, and initiated us into the technical secrets of a balloon service. But the improvised division which sent up a balloon once before Strasburg did not show itself equal to what had been claimed for it, and was not utilised at the siege of Paris. The prevailing opinion in Germany after the war was against the formation of a military aëronautical service, and a wave of hostile popular feeling showed itself when the Drs. Wölfert and Baumgarten carried out various experiments at Charlottenburg with a gas balloon. The next event was the formation in 1881 of the German Society for the advancement of aërial navigation. The first object of this Society was naturally to have and use the balloon; but, as it was not easy to get the necessary means, it at first contented itself with the clearing up of various aëronautical difficulties in so far as the limited aëronautical experience of its members would allow, and with the carrying on of a lively propaganda on behalf of the formation of a military balloon service. The Society also brought out from the year 1882 till 1900 a monthly journal. There is no doubt one must ascribe it to the efforts of this Society for the establishment of a balloon service that in 1884 the War Minister decided to form a balloon detachment, to-day developed into our balloon battalion. But for the Society, this separation of the military interests seemed as though it would be fatal, for it was gradually borne in on the members that now it would be long before they could have a balloon

Luckily, just at this moment, the science of meteorology began to arouse a deep interest in Berlin. Its new representatives decided to take up a Society, and with it a new scientific ideal in the pursuit of investigation in the upper atmospheres. Thus, through the new general interest, the Aëronautical Society now became a union of the practical active balloon officers and of the theoretical and cultured meteorologists who had preceded them. It contained only one aviator, but he was world-known, Otto Lilienthal, the inventor of soaring-machines—now a school in itself—and he fell a martyr to his experiments. It had at this time but few members, but these few had their object steadily before them, and they were men who could devote themselves to a cause undertaken. Names such as those of Bezold, Assmann, Berson, Gross, and Süring speak for themselves. But, after all, what would they have attained without the supreme interest and munificence of His Majesty the German Emperor? The German Society for the Advancement of Aërial Navigation owes to His Majesty alone the fulfilment of its wish, which to-day all lies open before him in that great work, "The Scientific Balloon Journeys of Assmann and Berson." So we have already in the Berlin Society a "new departure" behind us, and again the question arises, what next? when in consequence of numerous scientific successes meterological air journeys have become an institution, and actually a State-supported aëronautical observatory flourishes near Tegel.

But the answer is ready to our question. The Berlin Society of late years occupies itself also with balloon excursions. We can hardly yet describe them as sport, but rather as a recreation for the idler members of our Society, and an introduction to the romance intrinsic to ballooning. Since then there has been an increase in the number of members, and the Berlin Society with its list of about 600 can describe itself as the largest Aëronautical Society in the world.*

I must now ask you to turn your thoughts in succession to Munich, Vienna, Strasburg, and other German and Austrian cities. One good result of our former condition of small States in Germany is, that we have inherited a spirited system of decentralisation. Germany has many heads, and each one has its own ideas, which in their reciprocal stimulation work for the greater good of all. So,

* Amongst our members we count His Royal Highness Henry Prince of the Netherlands, the Duke of Mecklenburg and H.H. Ernest Prince of Saxe-Altenburg.

In the year 1889, we find the Munich Society for Aërial Navigation growing from the mother city of Berlin, and to-day it counts 400 members, amongst whom are eight Royal princes.*

This Society, in its earliest organisation sought to combine theory and practice. Its means are not so ample as those of the Berlin Society; but its yearly reports, and also the numerous writings of its members in the "Illustrated Aëronautical News," shows that a very wholesome and helpfully active spirit as practically as scientifically aëronautical prevails within its circle. And indeed the names of Finsterwalder, Ebers and others of its members are known throughout the length of Germany.

In Austria-Hungary, the Vienna Society for Mechanical Flight stands in true brotherhood shoulder to shoulder with the Berlin Society for Aërial Navigation. It is the most aviatic of all the German Aëronautical Societies, and in this particular is a worthy and irreplaceable complement to them. It has about 100 members, and contains with many others, such well-known names as Ritter von Lössl, Kress, Popper, and Wellnev. It was established in 1887.

A very advanced Society, and one that is an important factor in aëronautics, is, that of Strasbourg. Here, under Hergesell, and with great efficiency, has been accomplished the long-time burning wish of meteorologists, namely, the establishment of the International Aëronautical Commission for Scientific Balloon Ascents, which, since 1898, has borne already and constantly such fruitful results to the science of meteorology. It was no easy thing to overcome political opposition and the pettinesses of personal jealousies, but we can say that it has been done in aëronautics, that intelligence has prevailed and barriers have been broken down, now that we are all animated with the same stupendous interest, for the raising of our science and of our culture.

At Strasbourg also, the "Illustrated Aëronautical News" was started, which to-day is the widely read and unique German aëronautical paper, the organ of all the German aëronautical societies. I hope the personality will be forgiven me when I say that I am very proud of having founded this newspaper. In this connection, I want to express my thanks to your President and my friend, Major Baden-Powell, for the kind support he gave me at that moment, and my regret that he tarries so long and so far from us still.

The recent drawing together of the best circles of German life has resulted in an increased interest in aëronautics. Already new societies are springing up in Augsburg and Dresden, and it is only a question of time how soon similar organisations will form themselves in other cities. One can put the number of those who showed themselves interested in the starting of our German Aëronautical Societies at a total of 1,350 members, and I think I can claim that at present in the matter of such a manifested interest in aërial navigation, we hold the record of the world. And we attribute this fact in no small degree to the supreme interest which His Majesty the German Emperor has extended to every aëronautical attempt.

I should like to say a few words over the share taken by our mechanical inventors in the advancement of aëronautics.

As in England and in France, there are with us too numerous experiments to catalogue, which, at the same time, do not call for long notice. I will confine myself therefore to those which not only embody new practical ideas, but which also have been put into some successful practice, and so have valuably contributed to aëronautical advance.

Just now the world rings with the fame of Santos Dumont. Everyone, however, who has followed the technicalities of the development of flight, knows that the young Brazilian has brought to light no new principle, and his success consists in the accomplishing of a feat ordered in advance. But the secret of his success lies entirely in his continued experiments, his improvements, and his again-re-repeated experiments. Santos Dumont made twenty-three experimental flights, Renard and Krebs made seven, Count Zeppelin three. Krebs and Renard had the advantage of being already practised military aëronauts, while other of our aëronautical mechanics and inventors first became aëronauts in their experiments only.

Three names carry with them exceptional experiences: Paul Haenlien, who took out his first patent in England in 1865 (see Brewer and Alexander, p. 32), and built an airship according to his ideas at Vienna in 1872; David Schwarz, who in 1898 put together the first aluminium construction; and Count von Zeppelin, who, through the use of many novelties, attained noteworthy experiences. I should fear to exhaust your patience if I went

* Their Royal Highnesses, Prince Louis of Bavaria, Prince Rupprecht, Prince Leopold, Prince George, Prince Arnulf, Prince Louis Ferdinand, Prince Alfonso, and Prince George Louis of Bavaria.

into the details of the work of these three men. I know that amongst you, as all over the world now far and wide, the principles of airship steering and building are well understood, and have been often tried. The rigid connection between balloon hoop and car, the removal of the propellers to nearer the centre of resistance, elongated rigid-kept frameworks, powerful light motors somewhat such as are used in automobilism, gas motors by Haenlien, benzine motors by Schwarz and Zeppelin, firm aluminium bodies, water ballast, and the regulation, in some part, of the vertical motion by the propelling power, also the self-ventilating double envelope essential for remaining long aloft, these, ladies and gentlemen, seem to me to be the salient points which have been seized upon by these three constructors.

The aëronautical industry has made great strides, mainly on account of the military balloons. The leading houses are the Continental Indiarubber Company, in Hanover; the balloon factory of August Riedinger, at Augsburg; and, lastly, the house of Lieutenants Parseval and Sigsfeld, the holders of the patents for the German kite-balloons, no doubt well known to you, for they to-day supply the world of aëronauts, and German kite-balloons, for military and scientific purposes, are used not only in Germany and Austria-Hungary, but also in Italy, Spain, France, Switzerland, Sweden, and North America.

We Germans have endeavoured to contribute our share amongst the nations to the development of a new-dawning and growing science. While in no way disparaging the work of others, may we not say without boasting that we fill our place amongst the nations. We do not feel that we have come to the end of our capabilities of labour. On the contrary, we are convinced that we Germans are called, amongst our other labours, to strive after aërial navigation, and to deliver in aëronautics, as in other matters, a share to the whole human race of many great and precious things to come.

The CHAIRMAN: Of course it is quite impossible for us to give the author a vote of thanks here to-night, so we shall convey your thanks to him through our Secretary by letter. I would like, however, to make some remarks on this paper, after which I should like to hear what others may have to say on the subject. As far as I understand, the Paper has treated the subject of balloons altogether, and I would like to explain some of the troubles which I do not think have been fully gone into in the question of balloons. Navigable balloons are generally made this shape. (Referring to diagram.) They are sometimes called fish-shape, sometimes cigar-shape. Now in order to force this through the air the centre of atmospheric resistance is about here. The balloon is very much larger than the car, and suffers a great deal more of the resistance of the air than the car itself, the car only consisting of a very light framework of bamboo. But the propelling centre is very much below the centre of resistance. Now it is necessary to put this a great deal below the balloon in order to put it on a level. In some French experiments the car has been placed at a very great distance below, but the farther the car is placed below the balloon the greater the centre of effort is below the centre of resistance, so that we find that in pressing the car this way the resistance of the wind pushing it back has a tendency to move the balloon in this direction. (Indicating.) The correct position for the screw would be on the same line as the centre of resistance, but then again we have a difficulty because it would require framework and something to transmit the power, and the framework holding the screw would weigh more than the balloon. And, consequently, we have this trouble, and this is what generally takes place, unless the balloon is inflated and is very full and tight the car is liable to move forward and throw this end of the balloon up into the air. The front end of the balloon becomes enormously inflated with the gas and the back end is empty, so that the balloon assumes this position in the air—the front end going up in the air and the back end falling down as you see. This has repeatedly occurred in France, and it appears it occurred again at Monte Carlo with Mr. Santos Dumont's balloon. The bag of air was not sufficiently inflated, so that when he started his balloon the point went up into the air and the greater part of the gas went into the other end, and the result was it assumed this position—(indicating)—and that is the great trouble which one has with the class of balloons. I should like now to hear what anyone else has to say on the subject.

MR. SPENCER: Sir Hiram Maxim, Ladies and Gentlemen,—I have listened with very great pleasure to the remarks that have already been made on the subject of aëronautics, and first of all I think it must be very useful to us to hear Sir Hiram's remarks on the St. Louis Exhibition. However, as Mr. Bruce suggests, it is well we should be represented there. Passing on to Major Moedebeck's paper, one of the earliest remarks is

that skin balloons and figures are now only made in Paris. I think Major Möedebeck certainly goes a step too far there, because it is generally known on reference to any of the price lists of balloon manufacturers that skin figures, as a matter of fact, are daily made in the small village in which we happen to be existing at the present time. As a matter of fact I might say that possibly for many years, even before the British Government took up gold beaters' skin for the purpose of manufacturing balloons we had balloon manufacturers whose business it was to make these toy balloons, and that gave the Government the idea of using skin. Then we come to Dr. Wolfert being mentioned. With regard to the three balloonists who had had a navigable balloon in Germany, to my knowledge this Dr. Wolfert and his colleague were the first two balloonists to take one of our petroleum motors up in a balloon. Dr. Wolfert and his system came to grief, the petroleum motor ignited the petroleum, the balloon was in flames, and the two of them in the first navigable balloon ever constructed in Germany were killed. Passing on to the final remarks Sir Hiram Maxim made with regard to the propelled balloon, there can be no doubt that the points he has raised are important ones, but they are points that are capable with intelligence of being overcome. For instance, as the illustration is drawn there, you see the line of force is more than the diameter of the balloon. Now in the navigable balloon which is at present being constructed in our establishment, the diameter of the balloon is 20 feet, and the car is 10 feet below. One understands that the 10 feet below does not give the line of power so very much below the line of resistance, but one naturally understands that from the very nature of the thing that you must keep the whole of your propelling power well below. That is a point which has to be considered and can be overcome by means of the trail rope to balance the whole lot. People who will not take adequate means to keep their balloon blown out tight must expect it to collapse. At all events, if you are going to propel a balloon rapidly through the air you must keep it tight so that it can force its way as well as a balloon ever can.

The CHAIRMAN: And now, ladies and gentlemen, a paper is to be read by a lady. What more could you ask for? Miss Bacon is the daughter of a very clever man who has for a long time been engaged in the subject of aëronautics and who has made numerous ascents, and I feel quite sure that we shall have to consider that the pièce de résistance here to-night is Miss Bacon's paper, and I shall listen with a great deal of interest to this paper.

Photography from a Balloon.

BY MISS GERTRUDE BACON.

I think what chiefly strikes one with regard to balloon photography is not so much its possibilities, though these are great, as its very strict limitations. The work of a camera aloft is bounded most severely by several natural obstacles which it is quite impossible to surmount, and certain very special conditions, not by any means always to be commanded, are necessary before a really good negative can be secured. The element of chance unhappily enters largely into the matter, so that it is impossible to count with any certainty upon the obtaining of satisfactory results, even when all things seem, to the eye at least, to be entirely favourable.

In pursuing this most fascinating branch of photographic art the first point is naturally the equipment; and here at once we are met by one at least of the limitations mentioned. All exposures made in a balloon must, of necessity, be instantaneous, for a balloon is always one of the most unstable of standpoints, and never for a single moment absolutely at rest. It follows then, in the first place, that none but a "snap-shot" camera, or one that can be adapted for snap-shot work, is any use aloft. Further than this the camera should be especially light and portable, for heavy apparatus is little loved by the aëronaut, who knows the importance of every ounce of extra weight in a balloon, and the effect it has upon the length of the voyage. For the sake of lightness, films, although less reliable and easy to handle, are certainly preferable to plates, in a balloon, more especially taking into account the ever-possible contingency of a rough landing. In view of rough treatment the camera chosen should be a fairly stout one—not liable to be readily broken or injured, and the shutter arrangement should be such that the very probable accident of the introduction of a grain or two of sand from the ballast shall not immediately ruin its instantaneous action.

One more requirement necessary in the ballooning camera is that the films or plates can be rapidly shifted, for once aloft, and the fair and unique views which we long to perpetuate follow each other so fast that it is

well-nigh impossible to keep pace with them. More particularly at the commencement of a voyage when the balloon is travelling, not only onwards but upwards, at a very considerable rate, do we want to secure pictures in a hurry; and such views, showing the rapid change of altitude, are generally the most interesting to be obtained in the air.

(Photographs shown.)

When the balloon is travelling rapidly near the ground, say as near as 300 feet, it needs a quicker exposure than there is ordinarily light enough to allow with an ordinary hand-camera, to prevent the photographs taken showing traces of motion. Speaking generally, 250 feet is the inside limit of balloon photography, except under very exceptional circumstances. We, at least, have no photographs taken under that height which are of the least value.

(Photographs shown.)

At 3,000 feet aloft we begin to approach the outer limit of what I may perhaps be allowed to call the "photographic stratum" of our atmosphere. Of course, there are exceptional cases, and exceptional days, when the air is vastly clearer than on ordinary occasions; but taking it as a whole we may safely say that 3,000 to 4,000 feet represents the limit up to which it is possible to secure good results. Nor is this hard to understand. Our atmosphere, as we know it, is full of particles of matter is suspension; be they dust motes or "water dust." Seen from below these particles are invisible to us, and for the same reason that the rest of the moon is invisible when we see her only as a crescent. In other words, the dark, unlit side only is turned towards us. Seen from aloft, however, the case is completely altered. All the particles then have their sun-lit sides pointing upwards, reflecting the light as so many little full moons; and it is the presence of this golden haze which spoils so many pictures by destroying the sharpness and definition so all-essential to a good photograph. Naturally, then, when any great thickness of this dust-laden atmosphere has to be penetrated by the camera lens an indifferent result is to be expected.

(Photographs shown.)

Mr. Percival Spencer has, indeed, secured very fair pictures taken up to a height of 5,000 feet and higher; but these have, if I mistake not, been taken either over or in the vicinity of the sea, when conditions are certainly unusually favourable to balloon photography from the increased presence of water vapour in the air, and in several of his pictures moreover, the distinction between land and water has made sufficient contrast to give some features to a view, taken from a height when all things are generally reduced to a dead level of colour and "texture" (if such a term may be permitted in this connection).

(Photographs shown.)

But there are other conditions, invisible to the eye, not to be detected or even suspected perhaps by the aëronaut, that make or mar the pictures from aloft, as the would-be photographer very soon discovers. On the occasion of the writer's first ascent, to take but one instance, though the day was to all appearance perfectly clear and bright, and though very successful photographs were secured on the ground both immediately before and immediately after the voyage, yet all of the films exposed from aloft were ruined by a haze, very palpable to the camera, though not specially so to the eye. On a later date when my father made an ascent from the grounds of Clifton College on the occasion of the British Association Meeting at Bristol, exceedingly good results were obtained under apparently disadvantageous circumstances; the hour being late, and the time mid-September, while the balloon traversed the usually dust-laden atmosphere lying over the town.

(Photographs shown.)

Many times since the same curious contradiction has been noted, an apparently altogether favourable day yielding indifferent results, and good negatives obtained in much darker and apparently in every way less propitious weather. In all instances where this has been observed, however, it has been shown that favourable photographic conditions have been obtained when the air is heavily charged with moisture; while the drier the atmosphere the less successful the pictures, even though the sun be shining brightly at the time.

(Photographs shown.)

The CHAIRMAN: Ladies and Gentlemen,—I think you will admit that my prophecy has been more than borne out by the fact. In regard to the dimming or paleing effect of the dust in the atmosphere and the difficulty that the photographer has to encounter in this respect, I might say that many years ago the greatest of all lecturers that we had in England, Professor John Tyndall, said: "I feel convinced that I can make just as good a sky as we have." Now then I think I could do it, for it only requires the least particle of dust

in the air in order to affect the negative of a photograph. Of course, in damp weather, as has been said here to-night, this dust is less abundant. Water produces no effect at all unless the air is below the dew point. If the water shows it is in little globules in the air, then, of course, it has a similar effect to dust; but the presence of water in the atmosphere does not affect the photograph at all, as I understand it, unless the atmosphere is cold, so that the water is visible to the eye in the form of fog. I think we may therefore conclude that it is the dust, that is bits of silica, lime, and organic matter in the air that forms the dust, which is so detrimental to photography. I now move a hearty vote of thanks to Miss Bacon for the very excellent paper which she has read here to-night.

(Carried by acclamation.)

Further Notes on the Barton Air-ship.

By Dr. F. A. Barton.

Mr. Chairman, Ladies, and Gentlemen,—Nearly three years ago I had the honour of reading before this Society a paper, in which I gave a short history of my various experiments in aërial navigation, the results I had obtained, and the conclusions I had arrived at; and as there are probably many here to-night who were not present on the former occasion, perhaps it would be as well if I briefly referred to those experiments again.

My first series of experiments were made in 1883, with a cigar-shaped balloon, below which was an elongated car, carrying a propeller at the stern and a rudder arranged on a light framework between the propeller and end of the balloon. The propeller was worked by twisted india-rubber bands.

The machine was only a big toy, but I was able to draw the following conclusions:—

1st. That it was quite possible to propel and steer an elongated balloon through the air, horizontally, provided a sufficiently light and powerful motor could be found.

2ndly. That there was no method of causing the balloon to rise and fall except by throwing out ballast or letting out gas, or by tilting the balloon by means of a sliding weight.

3rdly. That if the balloon were not properly filled and tilted ever so little, the gas would all rush up to one end, and that there was no method of bringing the balloon horizontal again.

4thly. That there was great danger of the propeller getting entangled in the rudder lines and, indeed, of ripping the balloon itself.

5thly. That the shape of the balloon is of great importance, as the after suction is a most important factor.

In my second series of experiments, I discarded the balloon altogether and made a machine consisting entirely of aëroplanes, some of which were fixed, others moveable. The whole of the aëroplanes were attached to a light framework of wire, which, in its turn, was rigidly attached to the car, which carried the propeller.

My experiments with this machine were somewhat of a limited nature, as the repeated falls which it had very soon twisted up the framework and broke the aëroplanes; however, I arrived at the following conclusions:—

1st. That the aërodrome or machine composed entirely of aëroplanes was the ideal machine for rapid transit through the air.

2nd. That the lifting-power of aëroplanes had been considerably underestimated.

3rd. That the great want of stability was the chief difficulty in the use of aërodromes.

4th. That even if this difficulty could be overcome by means of a carefully conceived system of aëroplanes, there would still be a great element of danger in working the machine, supposing that anything should go wrong with the motive-power.

On another occasion I carefully went into the subject of birdlike structures, having been told that we should never succeed unless we copied nature, but I never made any experiments with models as I was convinced that we could never put into any machinery that nervous system which enables a bird automatically by reflex action to adjust its feathers to the varying currents of the air.

For some years after the experiments which I have just mentioned, I did nothing further, although from time to time I used to turn the matter over in my mind, and it was not till the year 1898 when it occurred to me one day to make a machine combining the two principles, namely, an aërodrome with a superimposed cigar-shaped balloon.

The first machine which I made on this principle had a balloon 21 feet long, 5 feet diameter, made of gutta-percha tissue, below this was the aëroplane frame, composed of light wooden rods braced together by fine wire; this framework had a horizontal moveable aëroplane in front and a vertical aëroplane or rudder at the back.

Rigidly suspended from this aëroplane frame

was the elongated car which carried the propeller of four eight-inch blades, worked by a powerful clock which ran down in about 15 minutes.

I believe I was the first to hit upon this idea of interposing moveable aëroplanes on a suitably-constructed frame between the balloon and the car, and after an exhaustive search by myself and others at the patent office and in aëronautical literature I can find no anticipation of it.

I tried at first in the Public Hall at Beckenham on the 10th of March, 1899. It ascended with the greatest ease from the platform at one end, and was driven to the balcony at the other end, from which the plane having been reversed by hand, it was driven back, descending steadily to its original starting point. The plane was then placed horizontally and the vertical aëroplane or steering rudder put hard a-starboard, when the machine went round the hall, which was only 33 feet wide, five times in succession, keeping the same level throughout. The rudder being then reversed it went about four times round in the opposite direction, when the power of the clockwork was exhausted.

This experiment showed me that I had solved the question of aërial navigation, as the aëroplanes and steering apparatus answered in every respect the purposes for which they were intended.

A few days later I tried the machine out of doors, when there was a strong gusty east wind blowing. The balloon immediately rose about 50 feet in the air, and went away down wind about 300 yards, the limit of the line attached. Various experiments were then made, and though the power of the fan was nothing like sufficient to drive the balloon against the strong wind blowing, one important point was proved, that the action of the fan and aëroplanes kept the balloon perfectly steady and horizontal even in the strongest gusts. Before the balloon was started, in spite of its being held by two or three people, it pitched violently up and down and rolled from side to side. Directly it was started it kept perfectly steady, and it remained always quite level.

Fourth Airship.—Having found that the principle was correct, I made a larger balloon about 35 feet in length, adding various improvements that suggested themselves.

This machine was tried first on the 12th of May, 1899. There was a gentle breeze blowing, but too strong for the clockwork, which only weighed 4 lbs. in all, to drive the balloon against it. The clockwork was the same as had been used for the smaller balloon, but with a new fan, which gave better results.

I first experimented with it as a captive balloon, trying its lifting power, etc. I then wound the clockwork up to the fullest extent, set the horizontal aëroplane so as to cause the balloon to ascend and the vertical aëroplane to starboard so as to steer the balloon across the wind. Having opened a small hole in the top of the balloon I started the clockwork and cut the balloon adrift. Although there was but little lifting power in the balloon, the action of the aëroplanes caused it to ascend as it gathered way, and in ten minutes it had reached an altitude estimated by onlookers at 800 or 1,000 feet. I found not only that the balloon kept quite level but that it steered perfectly, sailing straight away across the wind. As the clockwork gradually became exhausted the balloon took a course nearer the direction of the wind, until in about 15 minutes the propellers ceased to revolve, when a most noticeable change took place and the balloon began at once to turn round and round on its axis like an ordinary balloon and drifted away with the breeze, finally descending at Bickley Park a distance of about 3½ miles after a flight of about 23 minutes.

I carried out altogether some three or four series of experiments with this balloon to satisfy myself on various points that were necessary for the successful working of one of full size, and considerably improved my original arrangements, modifying them so as to meet the difficulties that arose from time to time and working out the practical details.

Few people have any idea of the many questions that have to be settled in order to produce a successful airship, and it is only by continuous application and retaining the very best experts on the different kinds of work required, that this result has been achieved. I would like to-night to publicly acknowledge the invaluable help that I have received from those who have assisted me.

Amongst the experts I have retained are Mr. F. L. Rawson, the well-known consulting engineer for inventions, who has assisted me in working out the weights and strains and general details of the machine; Mr. W. G. Walker, one of the greatest authorities in the world on air propulsion, who has made a special study of air propellers and fans and the resistance of surfaces in the air, and has also carried out various series of experiments for the Institution of Mechanical Engineers, the British Association, and the Royal Society.

Mr. Walker has worked out the wind resistance of the machine and thrust which may be expected from the propellers when driven by the engines I propose to employ. Mr. Walker has allowed a liberal margin in his calculations, but says that there will be no difficulty in obtaining the speed required by the War Office, as the thrust from the six propellers will be nearly double that required to counteract the resistance of the machine when travelling at the required rate.

Mons. A. E. Gaudron, the well-known balloonist, who is the only man in England who has successfully experimented in the air with a motor-driven airship, has also been retained by me as my consulting aëronaut.

I have pleasure in showing you this evening a model of the airship, which is of the scale of 1-12th, that is, an inch to a foot.

You will notice that the aërostat is more or less cigar-shaped, the largest diameter being considerably forward of the centre.

The balloon will be made of the best Japanese silk and be divided into four compartments, one division being between the nose and the main body, another between the main body and the tail, and the main body divided by a third.

The divisions will not be tightly stretched diaphragms, but quite loose, so that when the gas in the nose and tail expands, the diaphragms will bulge into the main body.

Under ordinary circumstances the fore and aft compartments will be closed although there will be a special arrangement under the control of the aëronaut by which the gas can be allowed to escape, should the tension become too great after the diaphragms are fully expanded.

Inside the main balloon will be a balloonet or smaller balloon filled with air.

When the airship first rises from the ground the hydrogen gas with which the four compartments of the balloon are inflated expands, and the air is allowed to escape out of the balloonet by the aëronaut, who has control of the valves and neck of the balloon.

Over the balloon is a second covering of Japanese silk, which is called the chemise. the edge of it is indicated by the line running round the balloon longitudinally.

In the full-sized machine this edge will con tain fine stripes of bamboo bound together, so as to make one continuous bar, to which may be attached the cords which suspend the aëroplane frame.

Similar rods composed of split bamboo and bound round with fine cord are carried up to the nose of the balloon, and for a certain distance on to the top, whilst others again are carried from the nose along the side for an equal distance as the top bar.

The ends of these rods will be connected by circular pieces of bamboo, and there will also be a connecting circle half-way between this and the nose. These bamboos will be sewn in gussets in the chemise, and will greatly help to maintain the proper shape of the balloon when being propelled forwards.

Now the advantage of this chemise and arrangement of bamboos are many.

1st. It gives greater strength and rigidity to the balloon.

2nd. No cord, metal or roughness of any kind comes in contact with the balloon.

3rd. Under ordinary circumstances it will greatly prevent leakage of gas from the balloon as it is extremely unlikely that there would be two holes, one in the balloon and one in the chemise exactly opposite one another.

4th. In warfare, supposing the balloon and chemise were both penetrated by bullets or a shell, a certain amount of gas would undoubtedly escape, but as the balloon got smaller the two envelopes would slide over one another, until, in a few minutes, a portion of the chemise would cover over the hole in the balloon, and it would thus be self-sealing.

The arrangement used by Mons. Santos Dumont of having his car suspended by wire cords directly from the balloon, is, I consider, likely to be an element of great danger, as at any time one of these wires might snap and tear the balloon.

In his case, however, weight is the first desideratum, and everyone, I know, must have admired his energy, resource and pluck under some of the most trying conditions.

My object throughout my experiments has been to produce a machine which may be relied on, to navigate the air in all ordinary weather and at the same time to secure for the aëronauts and passengers the highest degree of safety.

Suspended below the balloon you will see the aëroplane frame, which, in the full-sized ship, will be made of tubular steel. This, when properly braced by steel wire in tension, makes an exceedingly light, rigid and reliable framework on which to support the aëroplanes, rudder, and car.

The aëroplanes you will observe are arranged in an entirely novel manner, and are also made to work in a new way to any tried previously.

The position they now stand is that which would be used when the machine is intended

to maintain an exactly horizontal position in the air, other things being equal. You will notice that the planes are perfectly flat and offer no resistance in the air on either their upper or under surfaces.

We will now suppose that it is required to bring the airship down to a lower level or to keep it on the same level when the lifting power of the balloon is greater than required, as, for instance, when the sun comes out from behind a cloud. To accomplish this the posterior end of the aëroplanes is raised by means of a wheel on deck, and you will now notice that instead of being aëroplanes they are aërocurves with a resistance on their upper surface which either causes the machine to descend or to keep the same level by increasing the weight to be lifted by the balloon as the case may be.

When it is required to take the airship higher or to keep it at the same level when the gas contracts, as, for instance, at nightfall, or even in the daytime, when the sun goes behind a cloud, the opposite proceeding to that which I have first shown you is done, namely: the back part of the aëroplane is lowered, and this forms an aërocurve which gives a still larger resistance on its under-surface. I say a "still larger resistance" because you will notice that the end can be lowered three inches but only raised two and a half, that is to say, it has a rise of one in five and a fall of one in four. The posterior vertical aëroplane is worked like any ordinary ship's rudder, by a wheel on deck. The top of the aëroplane frame is covered with a fine cotton net to prevent the balloon coming in contact with steel of the aëroplane frame.

From the top of the frame over the forward and stern propellers are arranged tubular steels like davits with a similar network stretched from one to the other. This is to prevent the balloon being blown on to the propellers in the event of a sudden squall catching it sideways. I am sorry I had not time to put this network and davits on to the model. The car, which is of an elongated form is suspended from the aëroplane frame by steel wires at intervals of two feet and tubular steel at intervals of 12 feet.

The car itself is made in the form of a light girder, and although shown in the model as brass, in the full-sized airship will probably be made of nickel steel or some other chemically or electrically treated steel. The deck of the ship is made of fine wire netting covered with Indian matting or some such light material; the length of the deck is 104 feet, and, with the exception of the platforms for the motors and steering-wheels, is only two and a half feet wide on its surface. The sides are protected by larger netting, along the top of which is a tubular steel connected with the tubular steel suspension rods.

This rod serves the double purpose of keeping the netting tight and of acting as a support for the petrol tanks which are ranged along it.

Each tank holds seven gallons of petrol and there are 36 of them in all.

The tanks are arranged in this form as a convenient method of storing. Over each motor is a light framework to which a petrol tank is suspended. The supply pipe to the carburettor can be attached directly to the tanks and is divided at the upper end, so that when one tank is nearly empty another can be placed in position and attached to the free end of the pipe before the first tank is removed.

It is proposed to take up only a very small supply of ordinary ballast in the shape of sand, but to utilize the petrol in case of emergency; also the water in the tanks which I now draw your attention to; the tanks are two in number and situated at the extremities of the deck. Each tank is capable of holding 40 gallons of water, and when the ship is ready to leave the ground and is properly trimmed each tank should be half filled with water.

These tanks are connected by pipes running under the deck to a two-way pump which is worked by a small independent motor.

By means of this pump the water is kept circulating between the two tanks continuously. Just in front of the helmsman is a pendulum which is capable of swinging fore and aft, whenever the airship moves out of a horizontal position. By a simple arrangement of levers, the swing of the pendulum either shuts off the water from passing along one pipe and opens wide the cock in the other, or vicê versâ, according to whether the ship is down in the bows or stern.

In the ordinary way when the ship is level both cocks are half open.

For the sake of explaining this I will give you the following illustration:

Supposing something goes wrong with the forward motor which requires the assistance of one of the other engineers to set right.

It follows that as the man from the middle or other end of the car walks along the deck the centre of gravity of the machine is altered and the ship would pitch down in the bows.

Now the pendulum arrangement comes into play, for directly the ship begins to sink in the bows the water is shut off from flowing from the rear tank to the one in the bows, whilst more water than usual is pumped from the bows to the stern, and this is automatically carried on until the pendulum is at right angles to the deck when the cocks are both half open again.

The contrary takes place when the bowman has to go to the stern.

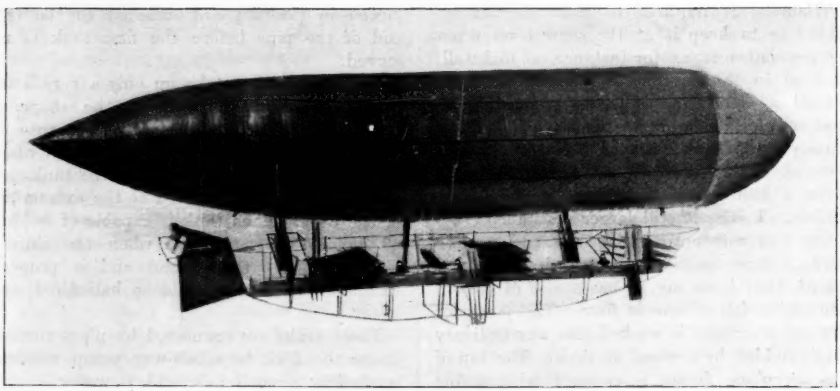
Although this apparatus works automatically as a general rule there is another simple arrangement under the control of the helmsman or aëronaut, who are both on the same platform, by which the pendulum can be fixed in any position, so as to cause the whole of the water to be pumped into one tank or the other.

This would only be required to be done supposing it were necessary to help the ascent or descent of the balloon by tilting it upwards or downwards in the manner employed by Count Zeppelin and Mons. Santos Dumont with their sliding weight and trail-rope. It could also be utilized in the event of the gas going up to one end of the machine, although this is scarcely likely to happen in the case of a balloon divided into compartments and fitted with a balloonet.

The tanks are, both fitted with large emergency cocks by which they can be emptied in a very few seconds, thus relieving the machine of about 400 lbs. weight of water.

There is some other arrangement for regulating the vertical action of the airship which is not shown in the model. At the present time this method is known only to my consulting engineer and your Honorary Secretary who has taken a very great deal of interest in my machine and has kindly written a report on it from an aëronautical point of view.

I am sorry I cannot tell you about this vertical steering arrangement, as it is, to my mind, by far the most important factor in my invention, and at the same time is remarkably simple. However, I have not taken out any protection for the invention, nor do I intend to do so at present. I am ready, however, to put this improvement together with several other important additions into my full-sized machine, provided the War Office make it worth my while.



The Barton Air-ship.

The only parts now remaining to be noticed are the propellers, which are six in number, arranged on different levels in pairs on each side of the car.

Each propeller consists, as you see, of six blades arranged in three pairs behind one another, on the "Mangin," or box girder type. They are, according to Mr. Walker, extremely light, rigid and powerful, and give far more thrust per h.p. and less slip than any other form of propeller.

They are 17 feet from tip to tip, and each blade is two and a half feet across.

They will travel at 250 revolutions per minute, each pair of propellers being driven by a 40-h.p. motor with four cylinders.

There are several other points I should much like to bring before your notice but the time is so short that I will not trespass on your

patience any longer. From what I have said I think you will see that in this machine which I am showing you this evening, I have been able, by combining the navigable balloon and aërodrome, to overcome all the difficulties which are experienced when using them separately. I think this machine will prove efficient, and above all safe, and will give us a grand opportunity of being able to experiment with aëroplanes without the danger which has hitherto attended their use; and that ultimately we may be able to reduce the size of the balloon very considerably.

I am extremely obliged to you for the attention you have given to this paper, and I hope before many months are over to be able to show you the full-sized machine in actual flight.

The CHAIRMAN: Ladies and Gentlemen,—I am sure you have all been very much interested in the paper which has been read to us. Still, I may say, I am of opinion there is too much machinery to catch the air beneath the balloon. In my experiments I found that it requires an immense amount of energy to drive a series of tubes and pipes through the air, much more than I had any reason to believe. Very curiously I found that two round bodies placed near together require more power to drive them sideways through the air than they did singly. The lecturer has spoken of the effect of aëroplanes; he says they are more than he expected. That is true in some respects, but not in other respects. I will give an illustration. This is an imaginary line, and we have a line down there which we call the sine of the angle. Now suppose, for instance, that this sine of the angle is two feet, and we will suppose that the distance from here is 10 feet, it will then be seen that when that plane travels 10 feet it will push the oar down two feet, and it was computed that the lifting effect would be just the same as it would be if air were blowing against the plane at a speed which would blow the plane downwards; it was said that the lifting effect, this being equal, was in proportion to the square of the sine of the angle. However, Lord Raleigh made some experiments, I made them myself too, but Lord Raleigh is a better authority than I am. Suppose the sine of the angle in this case is only one, consequently this ought to lift four times as much as that; but it does not. If we put two of these together on one end of a long arm and rotate it, that one ought to lift more than the two, but it does not; two of these lift more than one of these, so it shows when we have slight angles that the lifting effect does not increase in proportion to the square of the sine of the angle. Aëroplanes in which the sine of the angle is very small, lift a good deal more than they ought to according to the theory; but when the angle is very sharp they lift the same. The old theory has been in use in computing the power of sails for many years.

MR. SPENCER: Mr. Chairman, Ladies and Gentlemen,—I have looked with the very greatest interest on this proposed navigable balloon of Dr. Barton's, perhaps, I might say, because I am practically interested in ballooning and shall be propelled through the air, possibly over London, within a very short period. We have a balloon in course of construction, and, perhaps, that fact might be considered as putting me in a good position to criticise another machine, even though it is in the model form. I trust, however, that the remarks I may make which are made on the results of a full-sized balloon, may be of some use. Looking at the model of this balloon, the first thing that strikes me about it is that when it is made full size and filled with hydrogen gas it will not lift. I can see that a framework in that proportion, made with steel bars and with those heavy propellers and three 45-h.p. motor engines will probably be theoretically all that is intended, but when the thing comes to work I am afraid the weight will work out so great that the balloon will not ascend. That is the first broad principle that occurs to me. The diaphragms in the middle of the balloon are, undoubtedly, a useful step, but there is no doubt about it that these diaphragms will sooner or later if they are not protected with any means of escape, will burst if the balloon ascends to a very great height, because whether you have a balloon large or small, provided it is on an upward course, that balloon will ascend and ascend until the balloon, however large, is full; and then comes the time when you are in exactly the same position as you would be were your diaphragms small and with an open mouth—the gas will either slowly escape or it must explode the material that is confining it. The final idea that appears to be unique in Dr. Barton's invention is the system of balancing it by means of water ballast at each end. Now theoretically that sounds very nice for taking our propelled balloon through the air, but practically I am afraid that whenever that is tried on there will be the difficulty of the pumping work, and at the best I am afraid

we shall only keep up a see-saw motion that will be more troublesome and more dangerous than the simple scheme which our distinguished foreign visitor is adopting, viz: that he keeps a trail rope by which he can pull the weight entirely and easily over to one end or the other of the balloon. By that means you can keep the balloon on an even keel, providing it is full. That seems to me to be after all even simpler than the system of pumping water. Summing up the few remarks I have made, I am very much afraid that I must think in my own mind that everything that is really new in that balloon is not good, and everything that is really good in it is not new.

MR. REID: I should like to make one or two remarks. I have known this balloon, or rather not exactly this balloon, but Dr. Barton's balloon for some years. We have seen models here before, and there is one thing about it which I must say I especially admire, and that is the way in which Dr. Barton has accepted modifications and taken the best of the suggestions that have been offered to him by those who are expert in the different matters which come into the construction of a balloon. Now it is very likely, as Mr. Spencer has said, that if this model were carried out exactly 13 times, or whatever it may be, the size it is at present, it might not be exactly what is expected. We all know that a model does not exactly represent the thing itself on a large scale, but I have no doubt whatever that as Dr. Barton has made his experiments in a practical way, and has actually made balloons which have gone up and gone round and descended into people's gardens and gone almost on the same lines as Santos Dumont himself, that eventually when he comes to carry this out on a large scale it will be successful. There is one point I should like to criticise, and it is this, that I do not think the nose of the balloon is sufficiently rigid. I may not, perhaps, have understood the construction thoroughly. I believe it is split bamboo in gussets or something of that kind, but I should like to see the nose of the balloon made almost as rigid as it could be made, because if that does not take place, and you navigate a balloon of this kind against any considerable velocity of wind, the pressure of the wind against which you are going will probably cause a deformation of the nose of the balloon, and such a deformation would be greater than the planes which are to guide the balloon, consequently the balloon will not be guided by the planes, but rather by the front of the balloon. I think, with that slight modification, there is no reason whatever why the balloon should not work. As to the weight of the motors that are to be put into it, I must say that Dr. Barton, when he talked about three 45-h.p. motors, rather staggered me; but we have made such great advances in the power of motors, to which you yourself, sir, have contributed very much, that it is quite possible that such power might be got at moderate weight. But even if it is not so, it is not absolutely necessary to have such a power. I think myself that one 45-h.p. engine would be almost sufficient to propel the balloon against any wind that the structure of the balloon itself will stand. I think Dr. Barton is very much to be congratulated on the skill and thought which he has bestowed upon this problem. We see on the other side of the Atlantic, where you hail from, and on this side we see thought being continually devoted to this very important problem. One characteristic is very necessary in carrying out researches of this kind, and that is patience. Another is courage, and we certainly find that other nations are not behind us in the courage, but I do think the Anglo-Saxon race possesses the property of perserverance in the very highest degree. And we look forward to this problem of aërial flight, whether by balloon or not, I have a kind of conviction that it will be a member of the Anglo-Saxon race who solves it eventually.

MR. RAWSON: When Dr. Barton first came to me and my advice was taken as to whether this balloon would be practicable and would be able to fulfil the conditions of the War Office I was certain that subject to the calculations working out in the way expected that it would be a practical thing. The principal difficulty with flying machines is the question of rising off the ground and the question of getting on to the ground when you have done your work. With regard to what Mr. Spencer said, when Dr. Barton first came to me his intention was to lift about 6,000 lbs. I made a great many additions and alterations increasing the weight to be lifted up to 9,400 lbs., that includes a thousand pounds dead weight for ballast, and that can be utilised in case of difficulties. In the event of extra weight being carried, or in the event of the balloon being required to rise very rapidly that weight is to spare. I think Dr. Barton has not mentioned his various improvements which he has given to me, but the question of rising from the ground and descending safely I think has been entirely overcome, that being

the principal difficulty. I might just say that the real value of the invention is that for the first time we get a practical method of experimenting upon aëroplanes. The principle is this, that the balloon will go up about 2,000 feet and then you will rise to 5,000 or 6,000 feet, and in the event of an accident happening, you will only come down to the original 2,000 feet, and so one will be able to make experiments to one's heart's content. I am perfectly certain myself, that a satisfactory flying machine will be evolved. Sir Hiram Maxim has taught us what we should do, and I am perfectly certain the flying machine of the future will be somewhat on the aëroplane line.

MR. LONGWORTHY: I should be very much pleased if Dr. Barton could give us some little details with regard to these 45 h.p. motors. Lately, I remember seeing a note of some new petroleum motor which had been invented in France, and was safe to give 1 h.p. for each 2 lbs. in weight. That appears to be a very great advance on anything that has hitherto been done, and it would be very interesting to know what the weight of these 45-h.p. motors which Dr. Barton proposes to use is. If we take it as 2 lbs. per h.p. that represents a weight of 90 lbs. for the two motors. It seems to me very much below the weight of the motors used by Santos Dumont, and therefore it would be extremely interesting to have any information which Dr. Barton could give us in regard to the construction of these motors.

MR. GAUDRON: When Dr. Barton came to see me I saw his idea was practical and could be carried out on a vast scale, and so I had no hesitation in joining him to work it out. We decided the tapestry should be 160,000 cubic feet made in four compartments, and as the motors and car will weigh, with a thousand pounds of ballast, 9,400 lbs., I have no doubt we shall see his balloon rise the same as we have seen others which have been built over the past 24 years of my ballooning experience.

MR. MCNAIR: Mr. Spencer has cast a doubt on the lifting capacity of this balloon on a large scale. I can put the lifting power of this large balloon into figures. If the large balloon is inflated with hydrogen gas the capacity will be 160,000 cubic feet. That capacity at 70 lbs. per thousand cubic feet of hydrogen will give a lifting power of 11,200 lbs. Dr. Barton has told you that the weight of his car is 9,400 lbs., and I may tell you that the 9,400 lbs. includes the weight of the balloon and a thousand lbs. of ballast, so that you will see that it has a good surplus of lifting power and could take additional ballast if necessary. All the calculations for this balloon have been carefully worked out, and I do not think anybody, much less Dr. Barton, who has given so much attention to the matter would continue experiments under the advice of experts if he were not pretty certain of his results, and I think the greatest praise is due to him for the perseverance and tenacity with which he has gone on.

DR. BARTON: I think there is only Mr. Percival Spencer to reply to. When I was speaking about the diaphragms, I said at the same time that there were safety valves connected which were under the control of the aëronaut by which gas could be allowed to escape from the fore and aft compartments, if the tension became too great. The trail rope I think is a most dangerous thing. Santos Dumont has come to grief several times with it; it is always getting caught up and I think it is very dangerous. This arrangement of the water ballast is very simple; it can be easily worked, and if it does not go right at any time you can simply let out the water and you are free from anything. There is nothing to catch in trees or telegraph wires or anything else. With regard to the weight of the motors, there are three 45-h.p. motors, and the three motors with everything complete will come to just under 1,000 lbs.—330 lbs. each. Santos Dumont is going to use them himself. I have seen about that motor you mentioned, I should very much like to get hold of it.

THE CHAIRMAN: Mr. Longworthy has asked several questions to-night. He said he has heard of a motor that only weighs 2 lbs. per h.p., I do not know who the authority is; I think it is Mr. Pennington. Some years ago he made an extremely large balloon for the purpose of taking fruit from Chicago to New York, and he was also going to bring coal and bricks down to New York City. There was only one trouble about it and that was it wouldn't work. Now I have to criticise Mr. Spencer. He thinks it won't have lifting power enough; the thing is out of proportion; it doesn't appear that the balloon is big enough to lift all that machinery. Well, again we shall have to appeal to that great authority, Mr. Pennington, of Chicago. Mr. Pennington made a balloon—or at least a pattern of one—in which he had many accommodations, smoking room, marble staircase, ladies' room, library, piano, and so forth. You may ask how he got the lifting effect. It is the easiest

thing in the world, all the machinery and furniture were made hollow. Then it was found it wouldn't hold up, but he got over that by pumping more hydrogen in, and hydrogen as you know, has a distinctly lifting effect. So all these troubles were solved by Mr. Pennington. (Laughter).

I wish to call your attention to some prints that we have here to-night by the Hon. C. Rolls, who has a very fine historical collection of everything relating to aëronautics, and we have also a fine collection of photographs from Miss Pilcher. She is an hon. member of our Society, and she has given us everything that is left from the effects of her brother, relating to aëronautical subjects. Some of them are most interesting, and we feel very thankful to Miss Pilcher for them. May I offer a vote of thanks to Dr. Barton for his paper relating to this machine.

MAJOR TROLLOPE: Ladies and Gentlemen,—It affords me great pleasure to be asked to propose a vote of thanks to our Chairman who has kept us amused in many ways. I am perfectly certain you will agree with me that we could not have had a better Chairman.

Carried with acclamation.

The proceedings then terminated.

Applications for Patents.

(*Made in January, February, and March.*)

Compiled by BROMHEAD & Co., 33, Cannon Street, London, E.C.

25,760. December 17. HOWARD LANE. **Improvements in or Connected with Navigable Balloons.**

25,867. December 18. CARL RITTER VON BLUMENCRON. **Improvements in and Relating to Balloons and the like.**

26,125. December 21. ALEXANDER WINTER and JOSEPH LEVI. **Improvements in or Relating to Means and Appliances for Directing the Navigation of the Air.**

26,390. December 23. JOHN LENN. **Improvements in or Connected with Navigable Balloons or Flying Machines.**

245. January 3. HENRY CHARLES OSCAR MAWHOOD. **Improvements in Navigable Aerostats.**

623. January 9. WILLIAM G. HICKS. **Flying Apparatus for Toys and other purposes.**

693. January 9. WILLIAM ARTHUR PERCY WERNER. **Improvements Relating to Aerial Ascension and Propulsion.**

1,281. January 16. WILLIAM MILLER WALTERS. **Improvements in Appliances for Raising and Moving Bodies in the Air.**

2,812. February 4. ANTON NEUMAYER. **Improvements in Navigable Air-Ships.**

2,845. February 4. ALFRED JULIUS BOULT (for CESARI FEROCI, Italy). **Improvements in or Relating to Aerostats.**

2,923. February 5. EDMOND DAVID. **Improvements in the Employment of the Movement of the Recoil of Arms for Propelling Balloons or other Aerostatic Vessels.**

5,020. February 2. ANDRIE DELFORT. **The Flapping or Paddling Flying Machines.**

5,261. March 3. EARDLEY DELAUNEY BILLING. **Reversing Gear for Motor Launches, Air-ships, &c.**

6,300. March 14. ALFRED HARDIE. **Improvements in Connection with Aeronautical Machines.**

NOTICE.

Owing to the unusual length of the last General Meeting of the Aëronautical Society, and consequent pressure upon our space, the Notes, Foreign Aëronautical Periodicals, and Notable Articles, are held over to the next issue of the JOURNAL.